Lighting Control based on Colors Associated with Lyrics at Bar Positions

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Abstract. This study proposes a control method for changing light to a suitable color according to the timing of a bar position in synchronization with the music. The aim is to provide users with more realistic experiences when they are enjoying online live performances at home by changing light colors to match the music. Conventional methods switch the light for each word, and there are some variations associated with words within lyrics. Therefore, the proposed method increases the variations of the color image scale and the colors associated with the words to match the lyrics and song information. Moreover, our system is designed to change the lighting color at the timing of each bar position based on beat estimation from the song.

Keywords: lighting control, lyric, color image scale

1 Introduction

Online live performances have been increasing as part of the new life styles that emerged during the COVID-19 pandemic. However, watching live-streaming performances at home tends to be less present than watching in person due to insufficient lighting effects, venue size, and sound volume. As a result, participants only have partial enjoyment of their experiences.

The aim of our study was to consider a method that could easily create lighting effects suitable for songs without specialized knowledge. The previous study [1] developed lighting control on the stage, and the system incorporated 300 words that corresponded to a color image scale [2]. This color image scale was developed psychologically to define the common senses of color images and facilitated the classification and correlation of images of words within lyrics. We apply this idea to the PHILIPS Hue Go portable accent light [3], which can be used in the home. However, it should be noted that the timing of the lighting transitions in the original scheme did not match the song.

* This work was supported by JSPS KAKENHI Grant Numbers 20K19947 and 22H03711.

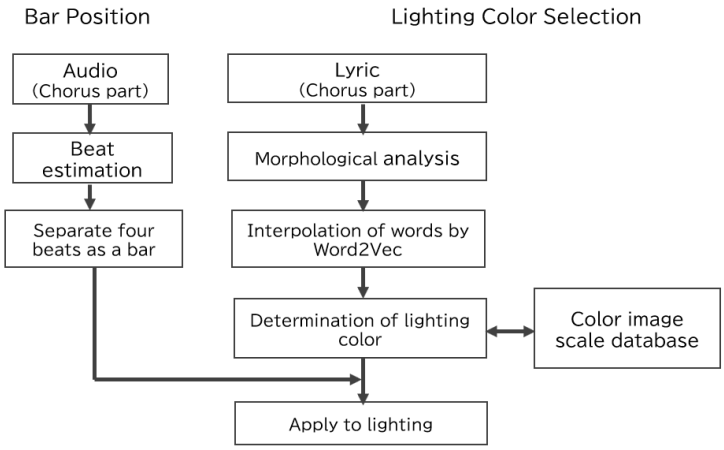

Fig. 1. Overall view

In this study, a lighting control method was developed that instigates light transitions at appropriate timing using the colors associated with words within lyrics. This is achieved by changing the lighting color at bar positions containing each word. In addition, we increase the number of image scale color variations to 1,317 words, allowing the method to suggest light colors that match the impression of lyrics more effectively.

2 Methods

Figure 1 provides an overview of the proposed method, in which there are two main processes: estimating bar positions from acoustic signals and selecting colors from a color image scale that match each word in the lyrics. It should be noted that we only focused on the first chorus part of songs.

2.1 Bar Position

Bar positions are often helpful in providing hints for the locations of structure boundaries and turning points within the music. Thus, we extract bar positions to switch the lighting color according to appropriate timings in the music. We estimated the time of each beat [4] and calculated the bar position time assuming a time signature of 4/4.

2.2 Lighting Color Selection

We search for the appropriate image scale color for each word in the lyrics according to the following procedure.

1. Extract nouns and adjectives from lyrics using MeCab (Yet Another Part-of- Speech and Morphological Analyzer) [5]. For the model dictionary, we used mecab-ipadic-NEologd [6], which is robust for new words and proper expressions.

Fig. 2. Example of lighting "*CHE.R.RY* (Artist: YUI)" (upper left: koi / love, upper right: hoshi / star, lower left: cherry, lower right: message.)

Table 1. Time [s] to switch lighting color "*CHE.R.RY* (Artist: YUI)."

Word Japanese / English	Previous	Proposals
Koi / Love		
Hoshi / Star	7.428	
Yoru / Night	1.005	6.594
Negai /Wish	0.814	
Cherry/ Cherry	2.673	
Yubisaki / Fingertip	1.144	4.389
Kimi / You	1.162	
Message / Message	0.060	2.206

2. Obtain embedding vectors for each word using Word2Vec [7] and the pre-trained Japanese Wikipedia entity vectors [8]. Each word is then complemented based on the word in the color image scale database using highest cosine similarity.
3. Search for the bars in which each word appears from the lyrics information separated into bars.
4. Select the word with the highest cosine similarity once every two bars.
5. Set the image scale color as the lighting color based on each selected word.

2.3 Apply to lighting

We used the Philips Hue API to set the lighting colors and start timing to Hue Light using RGB values based on the color image scale, and the start time of the bar in which the word appears. To represent the lighting color in the XYZ color space, we converted the RGB values to xy color space.

3 Demonstration

We conducted simulations of lighting effects based on the proposed method. Figure 2 displays an example using "*CHE.R.RY* (Artist: YUI)"[1], and Table 1 presents an example of words and switching times in the song "*CHE.R.RY*."

The proposed method selected four of eight words for the lighting color. Each word appeared in bars 1, 4, 6, and 7. In the proposed method, the word with the highest cosine similarity was "cherry," and its similarity was 1.0. Conversely, the lowest similarities were 0.471 for both "message" and "arigatou (thank you)." In the simulation based on the method of the previous study, all eight words were used as the lighting color. The highest similarity between words was 0.466 for the words "kimi (you)" and "ureshii (happy)." In contrast, the lowest similarity was 0.256 between "hoshi (star)" and

[1] Our demonstration movies are available at https://scrapbox.io/uemaiklab/Lighting_Control_Demo

"mabushii (dazzling)." The increment of the word variation in the image color scale also increased the variety of lighting colors. We assumed that we had enhanced the harmony between the music impression and the colors associated with the lyrics.

Table 1 displays the time corresponding to each word and the time required for each method to switch to the next light color. Table 1 indicates that the longest and shortest times for the proposed method were 6.594 and 2.206 s, respectively. In contrast, the longest and the shortest switching times in the previous study was 7.428 and 0.606 s, respectively. In the previous study, there were five locations where the time until the color switched was 1 s or less. This indicated that frequent switching of lighting colors occurred. We consider that the proposed method improved the temporal harmony because the colors were only switched for each bar.

We also found that words whose meanings were the exact opposite of each other when using Word2Vec were sometimes candidates as the most similar words. For example, "kanashimi (sadness)" was complemented with "yorokobi (happiness)." This could be because the model was trained to assume that words appearing in the same context have similar meanings.

4 Conclusions

We developed a lighting control method using colors associated with lyrics through word embedding and the color image scale. Furthermore, we improved the lighting timing by transitioning at bar positions instead of at each word. Ultimately, our proposed light system illuminates with appropriate colors and timing.

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